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Quality and Grading of Natural Rubber

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Edited by C. E. T. Mann on behalf of the Board of the Rubber Research Institute of Malaya

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PROCEEDINGS

of the

MEETING TO DISCUSS

THE QUALITY AND GRADING

of

NATURAL RUBBER

held under the auspices of

THE RUBBER RESEARCH INSTITUTE

OF MALAYA

on

September 12th - 14th, 1949

in

Kuala Lumpur

FOREWORD

The quality of natural rubber has always been a topic of interest to rubber growers and technologists but not until recently one of vital importance to the whole industry. With the rise and rapid technical development of the American synthetic rubber industry natural rubber producers are becoming more and more convinced of the urgent need to improve the presentation and, if possible, the intrinsic quality of their product, and to make use of any knowledge which may help rubber to maintain its position in competition with synthetics.

The Board of the Rubber Research Institute of Malaya, believing that improvements in production and marketing can only be secured by close co-operation between producers and their research and marketing organisations, decided to call a meting at the Rubber Research Institute of Malaya, Kuala Lumpur, at which representatives of all branches of the industry in Malaya might discuss with their technical officers and with research workers from abroad problems of current interest and plans for future work.

The Meeting was held in September, 1949, and a record of the discussions is now published together with abstracts of some of the technical reports which were tabled at the Meeting.

Thanks are due to those who contributed to the discussions and particularly to those who travelled from Europe, Indonesia, Indo-China and Ceylon in order to attend the Meeting.

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MEMBERSHIP OF THE MEETING

Group A—Members of the Staff of the R.R.I. and Representatives of Overseas Institutes for Rubber Research.

R.R.I. Staff

Mr. C. E. T. Mann, (Chairman of Meeting)	-	Director, Rubber Research Institute of Malaya;
Mr. M. W. Philpott	-	Head of Chemical Division, R.R.I.;
Mr. H. Fairfield-Smith	-	Statistician, R.R.I.;
Mr. L. R. Davidson	-	Smallholders' Advisory Officer, R.R.I.;
Mr. H. C. Baker	-	Chemical Division, R.R.I. (seconded from the London Advisory Committee for Rubber Research (Ceylon and Malaya);
Dr. G. Bloomfield	-	Chemical Division, R.R.I. (seconded from the B.R.P.R.A.).

Overseas Visitors

Dr. Geoffrey Gee	-	Director of Research, British Rubber Producers' Research Association, Welwyn, England;
Mr. George Martin	-	Superintendent of Rubber Investigations, London Advisory Committee for Rubber Research (Ceylon and Malaya);
Dr. E. Phillis	-	Director, Rubber Research Scheme, Ceylon;
Dr. Ir. R. Houwink	-	Director-General, Rubber Stitching, Delft, Holland;
Dr. Ir. G. J. van der Bie	-	Director, Indonesian Institute for Rubber Research (I.N.I.R.O.), Buitenzorg, Java;
Drs. G. Verhaar	-	Rubberbond (C.P.V.), Experimental Station, Buitenzorg, Java;
Ir. O. B. Schrieke	-	Representing A.V.R.O.S. Experimental Station, Medan, Sumatra;
Mr. P. Compagnon	-	Director, Institute of Rubber Research in Indo-China (I.R.C.I.), Saigon, Indo-China;
Mr. J. S. A. Souman	-	Bureau of Native Rubber, Department of Agriculture and Fisheries, Batavia, Java.

Group B—Scientific Officers, Technologists and Specialists from Producers' Organizations in Malaya.

Mr. L. J. Thompson	-	Boustex, Ltd.;
Mr. D. W. Pounder Mr. T. H. Barnwell	-	Dunlop Malayan Estates Ltd.;
Mr. J. Kielsgaard-Nielsen	-	East Asiatic Co., Ltd.;
Mr. C. Thornton Mr. D. G. Wright Mr. J. L. K. Brown	-	Guthrie & Co., Ltd.;
Mr. N. G. Cumming	-	Harrisons & Crosfield (Malaya) Ltd.;
Mr. J. H. Pidford	-	H & C Latex, Ltd.;
Mr. Low Guan Onn	-	Lee Rubber Co., Ltd.;
Dr. E. M. McColm	-	Malayan American Plantations Ltd. (United States Rubber Co., Ltd.);
Mr. I. Sibiriakoff Mr. J. D. Hastings	-	Socfin Company Ltd.;
Mr. G. B. Reginato	-	Pasir Planjie, Johore.

Group C—Representatives of Rubber Planting Associations and Societies in Malaya.

Mr. K. J. Sinclair Mr. H. K. Dimoline	-	The United Planting Association of Malaya;
Mr. Khoo Teik Ee	-	The Malayan Estate Owners' Association;
Tuan Sheikh Ahmad bin Sheikh Mustapha	-	Representing Malayan Smallholders;
Mr. T. E. Upton	-	Incorporated Society of Planters.

Group D—Representatives of Rubber Marketing Organizations in Malaya.

Mr. F. H. Atkinson	-	F.M.S. Chamber of Commerce;
Mr. Heah Joo Seang	-	(a) Penang Rubber Exchange; (b) Rubber Traders' Association, Penang and Province Wellesley;
Mr. Lim Chong Chee	-	Selangor and Pahang Chinese Rubber Merchants' Association;
Mr. F. J. Kemlo Mr. J. W. A. Newhouse	-	Singapore Chamber of Commerce Rubber Association.
Mr. G. E. Mott	-	Colonial Development Corporation (Far East) Ltd.

The following organizations received invitations but were unable to send representatives to the Meeting:

Institut Francais du Caoutchouc,
Singapore Chinese Rubber Dealers' Association,
Perak Chinese Rubber Dealers' Association,
Penang Chamber of Commerce.

TIME-TABLE

Session 1—Monday 12th at 10 a.m. **GROUP A.**

(a) Discussion of the technical problems arising in the specification of solid rubber, with the aim of agreeing at least the general principles.

The five topics to be discussed are:—

(i) Cleanliness;

(ii) Processability;

(iii) Vulcanization characteristics;

(iv) Variation of properties on storage;

(v) Effects of sulphuric acid coagulation.

(b) A brief exchange of views on the scientific possibilities of future developments in the production of solid rubber; notes on current programmes of work and future plans. Possibility of achieving:—

(i) Greater uniformity (What is our present knowledge of the extent of variability and its origin ?);

(ii) Improvement in important properties of vulcanization (abrasion resistance, resilience);

(iii) Better processing characteristics;

(iv) Specialized grades.

Session 2—Monday 12th at 2.30 p.m. **GROUPS A & B.**

(a) Summary of the morning's procedure and conclusions.

(b) A general discussion of the technical problems arising in the production of graded rubbers.

Session 3—Tuesday 13th, 10 a.m. to 12.45 p.m. and 2.30 p.m. **GROUPS A, B, C & D.**

(a) An appraisal of the situation of the producers of natural rubber.

(b) Report on sessions 1 and 2.

(c) General discussion.

(d) Immediate steps to be taken.

INTRODUCTION

GENERAL REVIEW

OF

NATURAL RUBBER PRODUCTION

By C. E. T. Mann

Rubber Research Institute of Malaya.

GENERAL REVIEW

OF

NATURAL RUBBER PRODUCTION

Until the outbreak in 1941 of war in the East, natural rubber had enjoyed, with some fluctuations in prosperity, all the advantages of an essential raw material for which no satisfactory substitute had been found. There was no other material a rubber manufacturer could use, although strenuous efforts by other countries to produce, for strategic and political reasons, a satisfactory substitute for natural rubber, and the keen interest shown in these developments by rubber manufacturers and by the powerful American oil companies had not passed unnoticed.

Geared to the rapidly developing motor car and transport industry, the natural industry had enjoyed on the whole a long period of steady expansion. But even in the decade before the war, the development of new rubber-like materials that could replace natural rubber for special purposes, and new products of the plastics industries, gave clear indications of an increasing challenge to natural rubber.

In the years between the two wars, the prosperity of the natural rubber industry depended mainly on the rate of consumption and cost of production. Because natural rubber had no serious rival it was possible for producers to regulate production by co-operative action so that production and consumption might be fairly well balanced. During this period the industry by means of research in the development of improved planting material and better methods of cultivation and production was able to reduce production costs. Whereas annual yields of 500 lbs. per acre were considered reasonably good 15 to 20 years ago, present-day average yields of 1,200 lbs. per acre from budgrafted areas are considered normal, and from the newest selections yields of 2,000 lbs. per acre have been obtained. Along with improvement in planting material and methods, other notable advances have been made in estate factory organization and the methods of preparation of natural rubber in the various forms in which it is now exported. The larger organiza-

tions have established central factories for the preparation of improved smoked sheet, crepe, and special products, such as concentrated latex.

It has been customary in Malaya to divide the rubber plantation industry somewhat arbitrarily into two principal sections—estates and smallholdings, and to regard properties of 100 acres and over as belonging to the first category and those of less than 100 acres, to the second. At the upper end of the scale are the large, company-owned estates, highly organized and operating in units of 20,000 acres or more, and producing in many cases special grades of rubber and latex. At the other end of the scale is the peasant smallholding of 3 acres or less, producing as a rule a low-grade product. Between these two extremes we find every type of producing organization, from the holding up to 10 acres—family owned and operated, through the miniature estate of 25 to 100 acres owned by a resident or non-resident Asian proprietor up to the large company-owned estates. This, in brief outline, was the structure of the producing industry before the second world war; an industry built up of units of every conceivable type and size engaged in the production of a natural product for which no satisfactory substitute had yet been found.

The manufacturer of rubber articles was obliged to purchase the produce of this industry, sometimes by direct contract between producer and user, but to a far greater extent through rubber marketing organizations. The manufacturer took the rubber he was offered and largely by his own efforts discovered ways and means of using it to the best advantage. The more progressive sections of the producing industry were alive to the need and the practical good business value of improving the quality of their product but, because the bulk of the manufacturers' needs had to be filled from the open market manufacturing processes had to be planned to use the general market product. The principal consumers of rubber were generally reluctant to pay a premium for specially prepared rubber, and this was principally because such material was seldom available in a sufficiently large quantity to make it worth while. There was in fact little incentive to develop the value of natural rubber by special attention to quality and liaison between producers and manufacturers was never sufficiently strong.

The second world war changed this picture for ever. Under the stress of the war, the synthetic rubber industry in America developed rapidly. At the end of the war the potential production of GR-S was approximately 1,000,000 tons per year. To achieve this remarkable goal it had been necessary to accept for large scale production the first satisfactory synthetic rubber that would satisfy the urgent need for a usable bulk substitute for natural rubber. The defects of the first-produced GR-S rubbers were well-known, but needs were too pressing to allow time for the patient research necessary to improve the quality of GR-S rapidly enough to supply the large quantities immediately required. When hostilities ceased and the rubber producing countries were re-occupied, natural rubber again became available. For a time the manufacturers were ready to take all the natural rubber that producers could provide, until the natural rubber hunger of the war years was at least partially appeased.

When natural rubber became freely available breathing space was provided for research teams and technologists, to concentrate upon the improvement of their synthetic product. In the huge synthetic rubber industry, built up during the years 1941 to 1945, research has been greatly intensified since the war, and has resulted in notable improvements in the quality of the synthetic rubbers which are now produced. The great importance of rubber in world economy makes it imperative to safeguard future supplies. On the grounds of national security, consuming countries find themselves unable to rely entirely on the natural product. Therefore, strenuous efforts are being made in America and elsewhere to maintain an efficient and progressive synthetic rubber industry. To this end, American rubber policy has been directed towards the protection of the new synthetic industry by the mandatory usage of a minimum quantity of about 230,000 tons annually and by the maintenance in standby condition of adequate producing plants. Operation of synthetic rubber-producing plants is backed by intensive research financed from state funds and probably to a far greater extent by the individual enterprise of the large rubber manufacturers. There are many indications that a considerable measure of success is being achieved by this powerful drive as witness the consumption of synthetic rubber in America during 1948 of over 440,000 tons, almost double the minimum mandatory amount.

Synthetic rubbers are produced in a wide range of different types, some of which have specific uses in which they are found to be superior to natural rubber. It is by the development of special purpose rubbers, none of which may possess all the valuable properties of natural rubber though any one of which may be superior to natural rubber in one particular property, that the synthetic rubber industry is likely to threaten increasingly the prosperity of the natural rubber industry.

The manufacturer of synthetic rubber is in a strong position for he is supported by the resources both in money and technical skill of the highly organized chemical industries. During the war years it was the rule for the technologists engaged in the manufacture of synthetics to work in the closest contact with the user. This close contact has enabled the manufacturer of synthetic rubbers to discover what the user needs, to try to provide it and to assist in making its use successful by the consumer. The manufacturer has begun to develop a liking for the new material, specified as to quality and properties, that the synthetic rubber industry is able now to provide and he is becoming more and more critical of the quality of the natural rubber he receives.

It cannot be too strongly emphasised that natural rubber has for ever ceased to be the only satisfactory material the rubber manufacturer can use; it is only one of a number of rubbers which the manufacturer can use or reject according to his requirements.

A comparison of relative prices, pre-war and post-war, for some of the recognised grades of natural rubber provides a strong indication of probable future trends. For example, before 1941 the difference in price between the best quality smoked sheet and lower grades of crepe rubber was comparatively small, and this was also true in the early post-war period when the urgent need for natural rubber induced manufacturers to accept it in any form without too much regard for quality. From the beginning of 1947, however, the differential in price between RMA 1 and, for example, clean brown crepe has increased steadily. In January, 1949, clean brown crepe was selling at about two-thirds the price of RMA 1. One reason for this may be that the manufacturer is developing a preference for clean GR-S supplied to him with a complete specification as to quality; with such material available he is prepared to accept the lower grades of

natural rubber only at a considerable discount. The manner in which the rise of the synthetic industry has directed attention to the importance of quality as a factor in the future marketing and usage of rubber is a matter of the greatest importance to the natural rubber producer.

It is necessary to understand clearly what is meant by the term "quality" as applied to rubber. It seems at the present time that the producer, the dealer and the manufacturer use the term "quality" in different ways.

To the producer who makes smoked sheet, a good quality product consists of a well prepared sheet of conventional standard size, perfectly clear when viewed against a bright light, free from all visible traces of sand, bark, "bubbles" or other impurities, evenly smoked and carefully packed, baled and marked, to satisfy the requirements of his agents and brokers.

The dealer requires the product to conform to the standards on which the planter judges it, but it is common experience that the dealer's appraisal of "quality" may frequently be different from that of the planter.

To the manufacturer, the most important considerations are cleanliness and the physical and technological properties of the rubber he buys.

The method of grading in current usage by the producer and the market gives the manufacturer no information about those qualities of the product that are of the greatest importance to him, except perhaps the quality of cleanliness in its narrowest sense. It is common knowledge to the planter who has seen the rubber from his own estate being used in the factories of Europe and America that the manufacturer pays little or no attention to the quality stamp that he or the dealer have placed upon it. It is clear that the natural rubber industry will have to compete with the synthetic industry more and more on a quality basis, and to be in a position to compete successfully producers must give immediate attention to their current methods of preparation, grading and marketing of their produce. There is little that is new in this standpoint; for many years past many of the most progressive producers have devoted attention to the production of special qualities and improved or new forms of natural rubber for export.

This principle of improvement in quality must be extended to the whole natural rubber industry, and it is certain that the future prosperity of the industry as a whole, of each producing territory and of the individual producer will depend upon the speed and efficiency with which the necessary work is undertaken.

In the struggle with the synthetic competitor all producers of natural rubber meet in a common cause. We realise that the problems of different producers will not be exactly the same and each will have to solve them in the manner he judges best. But, the broad directions in which we have to work are the same for all; it is hoped that the present Meeting will provide an apportunity for a valuable exchange of views and opinions on matters of the greatest importance to us.

C. E. T. Mann

SECTION I

PRELIMINARY EXCHANGE

OF

VIEWS

MEMORANDUM CIRCULATED BEFORE THE MEETING*

1. On the assumption that producers now recognise the urgent need to improve methods of preparation, grading and marketing of latex and natural rubber to meet the growing competition of synthetics and to extend the usage and consumption of natural rubber this meeting is proposed in order that rubber producers, representatives of the rubber market and scientific workers in the rubber producing industry may meet and talk over current problems. We feel that it is most desirable that the broad questions involved should be discussed and opinions exchanged on the problems that the rubber research organizations should set themselves to solve. Leaving aside the question of cost of production, which is largely an agronomic problem, it is hoped that the proposed meeting will provide an opportunity for an exchange of views on the kinds of improvement in quality, grading and packaging that are likely to assist most effectively in maintaining and increasing the demand for natural rubber.

2. It is desired to emphasise that the object of the proposed meeting is to provide for discussion among those who are closely concerned with the immediate problems of natural rubber production. We are not attempting to organise a full-scale Conference with large delegations from each producing territory. We believe that the urgent problems are well appreciated and that the cost in time and money, as well as diversion of effort from work of immediate importance, that a formal Conference must entail is not justified at this stage. In view of the many factors to be considered in relation to any one of the subjects to be reviewed we believe that more harm than good might well result from hasty or premature decisions. At the same time an early exchange of views and ideas, the object being to establish a workable basis for liaison between us, might be of considerable value and would prepare the way for more formal deliberations at a later stage.

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* As an introduction to the meeting the Rubber Research Institute of Malaya invited members to comment on the following memorandum which was circulated before the meeting. The memorandum does not purport to state the Institute's views but merely to provide a basis for discussion.

Several organizations contributed written replies, to this memorandum; extracts are quoted herein.

3. It is proposed that the meeting should be arranged in two parts:

(a) discussions between research officers and technologists on technical matters;

(b) joint discussions of proposals arising from (a) with representatives of producing and marketing organizations.

In the following paragraphs 4, 5 and 6 the principal questions which are suggested for discussion at the meeting are in italics. The technical aspects of these main questions would be discussed in the first part of the meeting and summarised for report to the second part of the meeting. In the discussions envisaged emphasis will be on the subject of quality of natural rubber and latex in all the forms in which they are, or may be, exported from producing territories. Improvements in quality can be divided broadly into three categories which may be considered separately.

4. Market standards have hitherto been based, and for the time being will continue to be based, on *superficial or visual standards* which embrace cleanliness, absence of visible defects, conformity to type, adequacy of package and the like. Many of the post-war complaints of consumers would be met if these standards were rigidly maintained.

It may be held that research stations can best help by perfecting methods of making clean rubber of good appearance and the producing and marketing organizations by adopting a more rigid code to ensure the observance of adequate visual standards of quality.

5. In the second category of improvement we include the development on a sufficiently large scale of *technically certified grades* of natural rubber and latex.

As a first step certain certified grades could be produced by conventional methods, or by minor modifications of conventional methods, for example—

(a) Super-clean rubber - of certified degree of cleanliness.

(b) Soft rubber / Toughened rubber - of certified plasticity.

(c) Fast, medium or slow-curing rubber - of certified rate of cure.

(d) Purified rubber	-	of certified protein and ash content.
(e) Rubber/carbon black mixtures	-	of certified composition.
(f) Latex	-	of certified stability, colloid properties etc.

Methods of making all of the above types are known in principle and could be applied by the larger producing units without large capital outlay; but the existing level or organization among producers is such that only the largest groups could successfully undertake manufacture of certified grades, because of the necessity for technical control of processing. The large-scale marketing of certified grades of the kind envisaged would entail the setting up by market organisations of testing stations with trained technical staff.

It will be for discussion to what extent should the producers' research organizations devote attention to the production of technically certified grades. The views of producers and the market on the desirability and practicability of this sort of certified technical grading will be welcomed.

6. Thirdly it is possible to visualise improvements in the *intrinsic properties of natural rubber*, i.e. in those properties which are believed to derive from the physical and chemical character of the rubber hydrocarbon. The properties to be considered here include resistance to abrasion, resilience, and resistance to oxidative degradation or ageing. Research on these problems might also concern itself with the preparation from latex or rubber of new derivatives having industrial applications.

Although no new large-scale technical developments are yet in sight investigations are proceeding (at the R.R.I.) on the following lines.

(a) Rubbers from individual trees (and clones) show real differences in tensile strength and resilience. Closer investigation of extreme types may indicate means of improving average rubber artificially.

(b) One method of improving resilience is known. Improvement up to 10 per cent has been obtained but the mechanism of the effect is not yet understood; it is being studied.

(c) The technological effects of changes which take place in rubber as it progresses from the tree to the finished product are being studied in order

to ascertain whether or not these changes are technically desirable, and whether they can be arrested or directed.

The field of enquiry envisaged in this section is admittedly speculative and there can be no guarantee that results of economic value will emerge. On the other hand the discovery for example of practical methods of making natural rubber more resilient or more resistant to abrasion might powerfully affect the position of natural rubber in relation to synthetics.

The balance that should be maintained by research organizations between the long-term investigations in this category and work that promises more immediate rewards will be for discussion.

7. It will also be for discussion with representatives of producers' and marketing organizations the order of priority that should be given to any proposals put forward. It is to be expected that discussion will centre chiefly upon the questions of improved methods of preparation and grading and the practical means to be adopted by all classes of producer to effect such improvements.

(a) There are those who hold the view that the best solution to many of the producers' problems could be found in centralized manufacture and processing; this may therefore form a special subject of discussion.

(b) The manner in which the advantages of centralized processing may be made available to all producers, irrespective of size of producing unit, follows logically upon (a).

(c) The need for closer liaison between producer, market and consumer is evident. Practical measures for effective liaison call for consideration. We need to know without delay how rubber research stations and technologists working in the industry can best assist both producers and the market to give effect to measures that will strengthen the position of natural rubber in its fight with synthetic competitors.

Comments on the preceeding Memorandum

British Rubber Producers' Research Association

We urge most strongly that the immediate need is to produce a substantial proportion of all natural rubber under conditions such that it can be guaranteed to conform to a reasonable and specified standard of cleanliness, plasticity and vulcanization characteristics.

Two different types of problem arise in achieving such a standard natural rubber, concerned with (a) methods of production and packing, and (b) methods of test and specification. So far as immediate possibilities are concerned, it does not appear realistic to consider methods of production basically different from those now adopted. Not only is the provision of new capital equipment to be minimised but there is every reason to believe that No. 1 R.S.S. represents an extremely good basic raw matrial. We proceed therefore from the assumption that all present attempts to raise the standard of smallholder production will be energetically pursued, and that insofar as these succeed, the problem of really dirty rubber will diminish in importance. In this connection, the proposals for a few large central factories appear attractive, in that they not only contribute to the immediate problem of upgrading the rubber produced by smallholders, but also provide a type of organisation suited to any more radical changes in rubber production which may subsequently appear desirable.

For some considerable time at least, a good deal of dirty rubber appears certain to be produced by smallholders, and under present conditions will exercise a depressing effect on the market, since buyers are sure to come forward if it is offered at a sufficient discount. It appears to us that at least as an interim measure, it would be both practicable and profitable to wash it to an agreed standard of cleanliness on suitable crepeing machinery installed in central factories. The cost of this washing would certainly be lower in the East than in U.S.A., for apart from lower wage costs, the rubber would generally be softer when freshly prepared than on receipt by the manufacturer. By these methods, we would like to envisage the realization, within a reasonably short time,

of conditions in which the export of dirty rubber could be prohibited, as being injurious both to the natural rubber industry as a whole, and nationally to the country of supply.

The other immediate production problem to be discussed is that involved in ensuring that rubber is not only clean but also as uniform as possible in its properties. Although in our opinion existing knowledge falls far short of giving an adequate picture of the extent of variability, there is no doubt that quite considerable variations do occur, depending on a number of factors some of which are uncontrollable (e.g. weather). Under these circumstances the only way to obtain large quantities of a single standard rubber is by adequate bulking at some stage. The first obvious approach to this is through the bulking of latex drawn from a considerable area, and its manufacture into sheet by a central factory. This appears technically desirable, but is by no means the whole answer. Not only would it take time and capital to carry through the necessary organization, but the extent of uniformity which would result remains in some doubt. We therefore wish to submit for consideration another approach, to be regarded as supplementary to the first, but considerably easier to establish.

Controlled Packing

The proposal arises from the realization that the smallest unit whose reproducibility is of interest to a manufacturer is a bale. Variations within a bale, unless very large, would be immaterial if each bale had the same average properties. This is an objective which seems to us reasonably within the scope of a large packing station drawing its supplies of rubber from many sources. Ideally, one might test each batch and blend them in each bale to ensure the required average, but in practice this would be impossibly laborious. As a practical alternative, our suggestion is that each bale be made up by drawing sheets either at random or in some systematic manner from the whole supply, while using up sheets from different sources at a rate proportional to the quantities available. The resulting bales would still vary in their average properties, but the variation would be much smaller than that of the separate sheets. This residual variability would be expected to diminish as production became more centralized, and the size of the separate batches received by the packing station increased. As to the scale of

operations, it is suggested that this planned packing might be carried out with lots of 10 tons. Each 10 ton batch would then consist of a number of bales which ideally would not differ significantly among themselves. It would be advantageous to adopt a new smaller bale for this standard rubber, so as to make it immediately recognisable. It may be pointed out that a similar process of randomisation could readily be applied during the washing and crepeing of off-grade rubbers.

Testing and Specification

The problem of testing and certifying rubber is itself a dual one. The first problem is the purely technical one of defining the tests which should be applied to rubber to enable its "quality" to be expressed quantitatively. In spite of much previous work and discussion, there is still a good deal of difference of opinion on this subject, and it is perhaps unlikely that the conference will reach unanimity even on general principles. Our own point of view is outlined in Dr. Fletcher's paper*, which gives also a progress report on an extensive investigation of the problem of variability in vulcanization characteristics.

When a decision, which need not of course be a final one, is reached as to methods of test, steps must be taken to organise facilities and personnel to carry out the necessary tests on a very large scale. This problem is considered in Dr. Blow's contribution†, which leads to the conclusion that an efficiently organised testing service, employing the methods we recommended, could be operated at a cost representing only a small fraction of a Straits cent per lb. It must be stressed that the actual figures and detailed recommendations given in this paper are only intended to be illustrative. This is particularly the case for the draft specification laid down. Here our approach would be to draw the specification initially in sufficiently wide terms to embrace a substantial part of all the rubber tested. This arrangement would be tentative, and subject to revision in the light of experience which might well indicate the desirability of defining more than one grade. We should however consider that our proposals for producing uniform rubber had proved inadequate if it were not found possible to embrace a large part of the production within say three or four grades.

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* See page 258. † See page 259.

First Steps

We should like to see the general programme outlined above accepted as a working guide in order to permit immediate action, in the first instance within national boundaries. We consider the first essential to be the appointment of a full-time co-ordinating officer with technical knowledge and administrative ability. His first duty would be to organize a central testing station and to find and train the necessary staff. Parallel with this he should seek to organise, in collaboration with packing stations, large scale experiments on the randomised packing of sheets as outlined above. Meantime, plans already in hand for centralized factories would begin to mature, and research work on methods of test would become available for his guidance. Within a year, it should be entirely possible to have in operation an experiment on a sufficiently large scale to be able to turn out very appreciable quantities of certified rubber. The total cost and effort involved to that stage would be trivial in relation to the size of the industry and the magnitude of the stakes.

Selling Certified Rubber

It would be unrealistic to conclude without reference to the probable reaction of the market—especially in U.S.A.—to these proposals. The manufacturer wants clean, uniform rubber only in so far as its added cost, relative to the mixed grades he now buys, can be economically justified, either by a saving in processing costs, or by an improvement in quality which it makes possible. Certain advantages he can already evaluate in cash terms, e.g. he knows what it costs him to wash dirty rubber and he would doubtless pay an equivalent premium (over the dirty rubber) to have it supplied clean. Other advantages will be less obvious and a problem of selling will arise in competing with synthetic developments and propaganda. In our view this will involve the preliminary evaluation of certified rubber by the research organizations, and the adoption of technical sales methods to introduce it to the market.

C. M. Blow

G. Gee

London Advisory Committee for Rubber Research

(Ceylon and Malaya)

It is not an easy matter to find out what is the relative importance of various factors in encouraging the demand for natural rubber. For most purposes American manufacturers prefer off-grades, suggesting that price is the first consideration. Some American manufacturers state that off-grades make better articles than first grade sheet, but they have not produced the technical evidence to support this claim.

The London Advisory Committee has a Technical Sub-Committee on which are technical representatives of important manufacturing firms in Gt. Britain, including one American firm which grades its rubber by rate of cure. The work of the Rubber Research Scheme, Ceylon and the Rubber Research Institute of Malaya is carefully studied by the Technical Sub-Committee and manufacturers freely express their views, which are undoubtedly helpful. Nevertheless, problems connected with the quality of rubber have so many aspects that it is difficult to obtain clear-cut answers to questions affecting commercial issues. Moreover, different firms have different opinions, and even in the same organization buying and technical personnel may adopt different attitudes.

When directly questioned about what can be done to improve natural rubber, most manufacturers reply in terms of present quality levels but ask for the elimination of manufacturing difficulties due to dirt and variability. It is desirable also to consider the possibility of better packing and marking of rubber, and small bales for the British market.

An alternative to technically certified grades, which are probably only possible with large scale production units, is a special mark based on regular estate inspection and perhaps test. This is not as satisfactory as certified grades but may be more practical, though probably unpopular, for medium-sized estates. A third method, suitable for rubber from miscellaneous sources, is for shippers to include in each bale rubber of the same grade from, say, at least 8 different sources, using some special mark, shape or size of package so that consumers may recognize bales so packed.

The advent of synthetic rubber has shown that a more fundamental improvement in natural rubber is desirable and some manufacturers are beginning to appreciate this.

The first sign of a change in the attitude of rubber manufacturers to the problem of better natural rubber came about 1938, when the Dunlop Rubber Co. stressed the importance of comparing rubber hydrocarbons from different trees with a view to discovering abnormalities. The main difficulty was to choose a test which would give the required information. It was eventually decided to recommend "solution viscosity" which was later changed on grounds of convenience to plasticity. The work was undertaken in the first place by Hastings and has yielded interesting and valuable information which has shown that some trees continue to yield soft rubber for long periods. Other factors being equal the preparation of soft rubber without extra cost is of considerable practical importance. This is a promising beginning but the work has not helped to find an improved hydrocarbon because the least and most plastic samples are not particularly different after vulcanization.

In the meantime more evidence has become available from the sources of synthetic rubber about the way in which an alteration in the physical characteristics of vulcanized material is likely to affect the demand for natural rubber. The most critical property limiting the general use of synthetic rubber is resilience, which is largely dependent upon the nature of the elastomer. For example, poor resilience in tyres leads to high temperature in running with poor resistance to abrasion and tear and increased risk of blow-out. The lower the resilience of the rubber, the more exacting is tyre design and the higher the petrol consumption. Early types of GR-S had a resilience value of about 40 (later much improved), the value for wild rubber (Funtumia and Landolphia) is about 50, and for plantation Hevea rubber about 60. It would be possible to quote different figures depending on conditions of test, but those given may be regarded as reasonably correct for comparative purposes.

One large tyre manufacturer reports that Fine Hard Para is more resilient than Plantation Hevea (rubber-sulphur mix) even when attempts to copy the Fine Hard Para method of preparation are employed.

Since the war, the search for rubber of improved resilience has been given priority by the Rubber Research Institute and London Advisory Committee and evidence has been obtained that it may be possible to obtain an appreciable improvement. The subject is, however, far from simple because of the complicating effects of the natural occurring non-rubber substances and the large experimental error associated with tests in carbon black mixes. Moreover, resilience can only be studied in a practical way in relation to other properties, for some of which laboratory tests are not very satisfactory.

Recent advances in synthetic rubber have shown that a small difference in molecular arrangement can lead to a marked improvement in resistance to abrasion when the rubber is associated with a special type of carbon black. There is a reasonable possibility, therefore, that natural rubber may vary in abrasion resistance, but laboratory methods of studying this problem are not yet adequate. The information available about the abrasion resistance of synthetic rubber is based on practical road trials. The British Rubber Producers' Research Association is making a scientific study of abrasion, and various firms in Great Britain are making co-operative studies of the relation between the results of laboratory tests and practical experience. For the present the chief hope for an improvement in natural rubber is that laboratory tests will show such a wide range of results that manufacturers will be interested in making practical trials. Experience so far, which is very limited, is not altogether encouraging, but it is emphasized that the range of such experience is at present very small.

There are other technical properties of vulcanized natural rubber which require study, if a fundamental improvement in quality is to be achieved. Like resilience and abrasion they are mostly dependent upon the relation between rubber and carbon black, which changes with circumstances. A fundamental study of this relationship, as a basis for technological investigations, is urgently needed.

An improvement in natural rubber which might be included when the required technical information has been obtained, is a "scorch-resistant" rubber. At various times manufacturers have put forward a request for this type of rubber. Now that American manufacturers tend to use higher and higher temperatures for processing

together with the introduction of new types of carbon black which encourage scorching, the need has become urgent. Synthetic rubber does not scorch as readily as natural and this is the chief reason why American manufacturers say that synthetic rubber is easier and cheaper to process than natural rubber. The examination of the scorching properties of a few samples of natural rubber has shown a range of scorching times from 14 to 60 minutes; this excludes evaporated latex which scorches in 5 minutes. If the scorching level of plantation rubber could be raised to that of the best sample so far examined without affecting other properties, the processing of natural rubber would be much easier. It is suggested that the preparation of rubber with reduced tendency to scorch is more important than the preparation of rubber of certified plasticity. The relation between tendency to scorch and rate of vulcanization in a rubber-sulphur mix should be studied.

G. Martin

The views of the research organizations and rubber producers in Java are set out in the recommendations (summarized below) of two committees set up in June 1949 by the Rubberbond of Indonesia.

Recommendations of Committee A.

1. To wage the battle against synthetic rubber successfully, rubber producers in this country ought to take in common effort all measures necessary to bring the quality of natural rubber to a higher level.

2. Following carefully the rules, given in the " Manual for the Preparation of Rubber " 1949, which ought to be made possible by technical equipment conform to the defined requirements, will substantially meet the demands of buyers, at least in so far as present-day judgment based on exterior quality is concerned.

3. Uniform packing, coating and marking of rubber bales is recommended; instructions are given in detail, in accordance with a similar advice of O.V.E.I.P./A.V.R.O.S. for S.O.K.

4. Regarding the problem of sampling bare-back bales, technical requirements and preferred commercial practice do not, in the opinion of our team, run parallel. For the time being continuation of sampling on the estate before pressing the bales is recommended.

5. Establishing central " factories " for sorting, packing and sampling rubber cannot be recommended.

6. The combined efforts of producers of natural rubber ought to be directed to a speedy introduction of measures to classify rubber according to interior qualities. Carrying these plans into effect is seen as a task of the Research Stations, for which reference is made in the preliminary report of Committee B.

Recommendations of Committee B.

1. Plans for centralization of rubber manufacture should be judged in the first place from the point of view that only in factories of sufficient size, enabling the engagement of a technically and scientifically trained staff is it possible in the long run to compete with the synthetic rubber industry.

2. There are various possibilities as regards the choice of the raw material to be delivered by the participating estates to the central factory, covering a range of possibilities from delivery of liquid latex down to the delivery of crepe and smoked sheet; whilst in the former case the highest ideal from the viewpoint of equalizing, grading, sorting and, last but not least, development of more modern end-products is attained, the possibilities in the latter case restrict themselves to centralized sorting, grading (on the basis of inner properties as well as on appearance) and packing. Therefore, the advantages of delivery of liquid latex to the central plant are evident.

3. In view of the above considerations any concrete plan should be tested first as to the possibility of economical delivery of liquid latex to the central plant, taking into consideration the transport costs involved as well as eventual other disadvantages. Having given consideration to the preliminary figures presented at the Committee's meetings, the Committee wishes to express it as their feeling that it is safe to say that in general the transport costs of liquid latex including other extra costs involved (conservation, more acid) after deduction of certain savings, will not likely be prohibitive in regions within a radius of e.g. 20 miles—a radius which includes certain practically important regions, like Bantam.

4. In case liquid latex transport to a central plant is not advisable economically or for other reasons, the possibility should be studied to bulk liquid latex at individual estates (or gardens) in quantities of at least 100 cu. ft. and then, either or not after pre-coagulation, to coagulate this liquid latex, either in one, or in more portions. In this way it will probably be possible to deliver coagulum to the central plant in sufficiently homogeneous lots. This coagulum can then in the central plant be converted into crepe, sorted into lots of well defined inner properties, as well as appearance, and be packed accordingly.

5. As regards the choice of the end-products, the writer believes the best development to be such, that the starting-point should be a central crepe factory, which could be extended gradually later to deal with more modern and delicate end-products. This procedure eliminates unnecessary initial risks.

In regions where, (a) for too high transport costs or for other reasons transport of liquid latex is prohibitive at least for the time being, and where e.g. delivery of coagulum to the central plant should be preferred, (b) liquid latex must be transported over too great distances (say more than two hours), the manufacture of smoked sheet in a central plant is impossible, or at least not recommendable.

6. It stands to reason that in those cases where the location of the central factory is favourable for the delivery of liquid latex and where the distance permits the manufacture of both crepe and smoked sheet, the choice of the end-product will also be influenced by the equipment, already or still available at the individual participating estates, in order to reduce the initial capital investment.

7. The Committee is well aware that the erection of central factories also involves certain consequences on the selling side, as it is natural to assume that the selling of the products of the central factory will in most cases (although not necessarily) no longer be a matter of the individual estates. It is hoped however that the higher interests which are here at stake will make it possible to conquer these complications.

J. G. van't Oever.

We would like to put forward the following comments as representing our thoughts on the points raised in the R.R.I. Memorandum and as a contribution to the general discussion.

We consider the improvement of intrinsic properties to be fundamentally the most important problem of all. We know that latex differs very considerably in its characteristics from one clone to another. We also know that the characteristics of latex from the same clone will differ with the seasons of the year. We do not know, however, how to adjust them so as to produce a uniform product. These differences must also exist to some degree in sheet or crepe. Furthermore there is as yet so little information about latex as it comes from the tree, or as regards its subsequent changes, that research of this nature seems to be essential if we are ever to understand what rubber is or can be when prepared for consumers' use. It is appreciated that investigations of this nature will involve a considerable amount of fundamental research but we believe that without this no real progress is likely to be made.

The subject of latex quality should be excluded from this discussion. The question of latex specifications is at present under consideration by the A.S.T.M. in America and the B.S.I. in the U.K. and we suggest that any technical discussion on quality before these specifications have been agreed, would be premature.

We believe that the provision of special grades of rubber is both technically and psychologically important; technically because there is a demand for them in limited quantities and psychologically because it would meet the claim that synthetic rubbers are tailor-made for specific purposes while natural rubbers are not.

We do not think, however, that many of these special grades would be required in large quantities, especially if their manufacture would, as seems probable, involve heavier expenditure. Furthermore it seems clear that the present marketing organization for rubber would be quite unsuitable for dealing with "tailor-mades" as opposed to rubber "off the peg" and that should the demand prove to be large it would be necessary for the distribution to be handled by firms with technical facilities and knowledge.

We believe, however, that the demand for special grades would be comparatively small, that the rubbers would be sold under the producers' names or trade names and that the sale would be direct from producer to consumer.

The problems connected with the production of rubber to conform to market standards are not unimportant but we do not consider that valuable time should be given to going over old ground. Methods of producing a clean rubber to market standards are well known. There have been many publications by experts and much valuable work has been done and pamphlets issued by the R.R.I. on the best methods of sheeting, drying, etc. It would seem to us, therefore, that it is now necessary only to invite attention to such publications and to impress on producers generally the necessity of following them.

The question of proper grading and packing to type seems to be of prime importance as this has, we believe, been one of the main causes for complaint from consumers.

It has been claimed by consumers that one of the advantages of synthetic rubber is its packing in small bales which are easily handled and which cut out one factory operation. The possibility of packing natural rubber in this way should be considered.

With regard to the possibilities of centralized manufacture, our own experience is that the centralization of sheet manufacture has not given the advantages hoped for and we believe that the only advantage which can be substantiated is the effect of bulking larger quantities of field latex and the resultant production of quantities of sheet with uniform characteristics. These views do not, of course, apply to any advantages which might attach to a scheme for co-operative or centralized manufacture of smallholders' rubber.

There should be direct contact between the research institutes such as the R.R.I. and the consumers. We do not think that without complete re-organization the market can help in any form of technological advancement but if the R.R.I. sets out on a firm policy of improving the quality or charactertics of natural rubbers, they will find that the manufacturers are interested and will contact with them direct.

D. W. Hawkins.

SECTION 2

REPORT OF SESSIONS

SESSION I (Group A) September 12th at 10 a.m.

Chairman Mr. C. E. T. Mann

(a) Technical problems arising in the specification of solid rubber

(i) *Cleanliness*

The development of a quantitative test for dirt is rendered difficult by its irregular distribution in rubber. Among known methods that of straining was generally considered practical and useful, but it is fairly slow owing to the need to employ large samples.

A modification of the solution method was described in which dirt is estimated by volume rather than weight.

It was pointed out that dirt was of many kinds, not all being equally deleterious.

It was agreed that further research was needed on methods of sampling and testing, and that the specific nature of dirt present should be more closely studied.

(ii) *Processability*

The manufacturer is concerned that different batches of rubber, submitted to a standard plasticating and mixing schedule, shall emerge with similar rheological properties, so that their behaviour, in say an extruder, is constant.

It was agreed that although the Mooney viscosity of the raw rubber gives only a crude indication of processability as thus defined, it is the best immediately available criterion, and one of value to the manufacturer.

Experience shows that while the Mooney viscosity of individual tree samples of rubber may vary widely, commercial production is covered by a much smaller range. It was therefore recommended that in grading rubber by viscosity, a "normal" grade should be established, with limits set so as to include the bulk of well-prepared rubber. "Hard" and "soft" grades should also be distinguished.

It was reported that manufacturers do not usually favour hard rubber, but the opinion was expressed that this rubber might well prove to possess inherent advantages if a suitable method of processing could be devised.

(iii) *Vulcanization Characteristics*

The problem of defining vulcanization characteristics

involves the choice of a suitable test mix and the establishment of suitable test methods, and specification limits. The problem of scorch is also closely related to that of vulcanization rate.

All were agreed that a gum stock was to be preferred to one containing carbon black, and there was general support for the view that the A.C.S. mix should be adopted at least for the present. A report that this mix is sensitive to moisture was noted for further investigation.

There was unanimous agreement that some form of modulus measurement on a vulcanisate represents the best available criterion of vulcanization characteristics, and that tensile strength should not be used for this purpose.

Interest was expressed in the development by the B.R.P.R.A. of a very simple "strain tester", designed to measure the modulus at elongations of the order of 100%, and it was agreed that this offered attractive possibilities as the basis of grading, both because of its speed and simplicity and also because it measures the modulus of the rubber under conditions closely related to those of practical application.

Some support was also registered for the retention of a specification of modulus at a high elongation, if only to emphasize the fact that a GR-S gum stock would be quite unable to meet such a specification.

There was a difference of opinion as to the need for more than one time of cure. On the one hand it was argued that rubbers differ independently in two characteristics, the optimum modulus obtainable and the optimum time of cure, so that at least two or three cures would be needed to define both these properties. On the other side it was argued that one cure not only represented the probable limit of practicability, but did in practice give an adequate basis for grading.

It was considered desirable to carry out investigations with a view to defining and improving the scorching properties of rubber since scorching is an important factor in limiting the usage of natural rubber in modern high speed processing used in America.

(iv) *Variation in Properties on Storage*

It was agreed that tests made here must be significant in the ultimate consuming country. Fortunately the changes which occur on storage chiefly affect plasticity

and not vulcanization characteristics, and are not therefore of great importance in view of the agreed broad range of plasticity within the " normal " grade.

It might be necessary to insist that the grading label would only apply to rubber stored under proper conditions.

(v) *Sulphuric Acid Coagulation*

It was reported that the results of recent work at the R.R.I. cast some doubt on the value of the older evidence of the deleterious effects of sulphuric acid coagulation.

A second paper submitted to the meeting reported evidence (based on accelerated tests) that rubber coagulated by sulphuric acid deteriorated more rapidly on storage than normal sheet. It was agreed that this matter required further study.

(b) Reduction in Variability

Experience has shown that rubber from a given source tends to be reasonably uniform over long periods, though there is evidence of a seasonal variation in some territories. It was felt that post-war changes in types of rubber, in tapping and in factory practices are sufficiently extensive to necessitate a re-investigation of this conclusion.

Control of maturation at the factory has been shown to be of major importance in reducing variability.

Time did not permit of detailed discussion at the formal meeting of the further topics included in this section. These were covered as far as possible in discussions between individual officers outside the meeting.

SESSION 2 (Groups A&B) September 12th at 2.30 p.m.

Chairman—Mr C. E. T. Mann

The second session received a report of the proceedings and conclusions of the first, and embarked on a discussion of the possibility of producing rubber to a technical specification.

The meeting had no doubts of the desirability of being able to supply the manufacturer with a rubber whose properties were matched to his needs, and agreed unanimously that means should be sought for the orderly introduction of a scheme of technical grading.

It was recognized that this should be considered only as a first and minimum defensive measure against the challenge of synthetic, and that constant research is needed to point the way to further advances.

A comment was made on the report of the morning discussion on cleanliness, suggesting that it should not be too lightly assumed that No. 1 R.S.S. represented a degree of cleanliness adequate for all practical purposes. Evidence was quoted that use of a super-clean rubber for tyre treads could—with adequate factory precautions against dirt—lead to such a substantial reduction in cracking as to ensure its serious consideration in opposition either to GR-S or to a cheaper off-grade natural rubber.

An account was given of the system of grading already being operated by French producers, whereby No. 1 and No. 2 R.S.S. are tested and individual bales marked on a dual basis of viscosity and rate of cure. Three degrees are recognised for each character, leading to a total of 9 markings, although in practice production is found to fall mainly in a few classes. This scheme has not yet been in operation for sufficiently long to be fully evaluated, but preliminary reports were stated to be encouraging. There was therefore general support in the meeting for a proposal to examine the applicability of the French methods to Malayan rubber.

Some discussion of the technical basis of specification was resumed along the lines of the morning session, and there was strong support for the adoption of the French method of specifying vulcanization characteristics on the

basis of a single cure, at least as a temporary measure. It was pointed out that any specification must be tentative and subject to revision in the light of further research and user demand. The need was also stressed to work in close relationship with the U.S. Rubber Committee, and with other bodies concerned with standardisation, and to seek international agreement between producers.

A serious problem to be examined arises from consideration of the size of production unit which is sufficiently uniform to be tested as a whole, and represented by a single bulked sample (i.e. a combination of a number of small samples which are not themselves individually tested). The method has hitherto been applied only to estates on which from 1,000 to 5,000 gallons of latex is bulked before conversion to sheet. A single bulked sample is then representative of a quantity of baled rubber of the order of 2-10 tons, and it was reported that under these circumstances the labour of testing is not excessive, and its cost only a small fraction of a cent per lb. If, however, the rubber were produced in much smaller units, it would become prohibitively expensive to test each unit separately.

One of the conclusions drawn by the meeting from the discussion of this testing problem was the need to encourage all attempts to replace manufacture in very small units by methods of manufacture involving the bulking of adequate volumes of latex (1,000 gallons or more). This is especially vital in the case of smallholder production, where centralized preparation and manufacture are greatly to be encouraged, to reduce variability, and to improve the cleanliness of the rubber produced.

Some members urged that much more should be done by responsible bodies to inform and encourage the smallholder in the principles of centralized manufacture, ideally on a co-operative basis, but if the growth of co-operatives should prove too slow, by any other satisfactory means.

Possible methods of extending technical grading to rubber produced in smaller units were discussed, but it was recognised that this problem requires much further investigation before firm recommendations could be made. It is not known at present whether the variability of rubber handled by a single dealer or a single packer is significantly less than that of Malayan rubber as a whole, or whether any worth-while advance could be made by

considering such a supply of rubber as a unit for the purpose of grading.

It was generally thought by members of the meeting that the rubber handled by a packer would show rather wide variability, and that it would be desirable to seek means of improving its uniformity. It was pointed out if this rubber could be sorted into sources showing reduced variability, then a systematic blending of these would in principle enable bales to be built up whose average properties showed a greatly reduced variability. Although there would remain variability between the sheets in a single bale, this would be of little concern to a manufacturer using not less than a whole bale at a time. It was agreed that this suggested method of improving uniformity would require much closer study as to its effectiveness with existing rubber sources, and also as to its practicability.

Whatever may be the system of grading finally suggested for Malaya, clearly its success will depend on the existence of adequate testing facilities. It was recognised that such facilities now available in Malaya are on a very small scale, and recommended that immediate action should be taken to expand them.

Summary of principal conclusions

(a) The session was unanimous in its opinion that it is desirable to introduce as rapidly as is practicable a system of technical grading for solid rubber.

(b) The system of grading already introduced by producers in French Indo-China was discussed and the proposal to examine the application of a similar system to Malayan rubber was fully supported.

(c) The need to work in close relationship with the U.S. Rubber Committee and other organizations concerned with standardization was stressed.

(d) The early adoption of specification grading should present little difficulty to large producing units (producing over 1,000 gallons of latex daily).

(e) There was urgent need to encourage replacement of manufacture in small units by a system of centralized manufacture, either by co-operation or other effective means.

(f) Particular reference was made to the need to develop methods of centralized manufacture by smallholders.

(g) The possibilities for the application of technical grading to the rubber handled by packers and dealers of different sizes should be investigated as soon as possible.

(h) Technical testing facilities in Malaya must be expanded as rapidly as possible.

SESSIONS 3 (Groups A, B, C & D)

September 13th at 10 a.m.

Chairman - Mr. C. E. T. Mann

1. The Chairman, welcoming members to the meeting, referred briefly to the research and advisory services (R.R.I. and L.A.C., and the B.R.P.R.A.) financed from the cess on rubber exports paid to the Malayan Rubber Fund. The danger to the natural rubber producing industry from the rising challenge of synthetic rubber, had brought about for the first time in the history of the R.R.I. a meeting at which all sections of the industry in Malaya were represented. The present meeting of forty men, including distinguished guests from rubber research organisations in other countries, all of whom are vitally concerned in the well-being of the natural rubber industry, may be fairly regarded as a representative gathering.

2. The session opened with a brief statement of the present position of natural rubber in relation to the synthetic product. A more detailed appreciation of the situation had been presented in a separate paper circulated to all members before the meeting. Reference was made to the steps that have already been taken since March 1949 by French producers in Indo-China, and to the proposals formulated by producers in Indonesia to supply natural rubber to the manufacturer, through the marketing organizations, in improved form and in a manner more closely related to his technical needs.

3. The meeting was informed of the principal conclusions reached in the technical discussions on the previous day, namely that:—

(a) The session was unanimous in its opinion that it is desirable to introduce as rapidly as is practicable a system of technical grading for solid rubber.

(b) The system of grading already introduced by producers in French Indo-China was discussed and the proposal to examine the application of a similar system to Malayan rubber was fully supported.

(c) The need to work in close relationship with the U.S. Rubber Committee and other organizations concerned with standardization was stressed.

(d) The early adoption of specification grading should present little difficulty to large producing units (producing over 1,000 gallons of latex daily).

(e) There was urgent need to encourage replacement of manufacture in small units by a system of centralized manufacture, either by co-operation or other effective means.

(f) Particular reference was made to the need to develop methods of centralized manufacture by smallholders.

(g) The possibilities for the application of technical grading to the rubber handled by packing and dealing units of different sizes should be investigated as soon as possible.

(h) Technical testing facilities in Malaya must be expanded as rapidly as possible.

It was also reported that many members of the technical sessions held the view that the ultimate solution of the principal problems of improvement in the value of natural rubber lay in large-scale centralized manufacture under technological control, but in view of the imperative need to act without delay it is necessary to concentrate for the moment on measures that can be applied at once.

Discussion

Observations of Market Representatives (Group D)

4. Market representatives asked what evidence there was of a demand for rubbers produced to a technical specification, and observed that before large-scale production of such rubbers was embarked upon, it was necessary to establish that a demand existed or could be readily created. It would be wiser to leave such developments in the hands of the large producing units and to concentrate on producing bulk rubber of cleaner and better type. Also from the market point of view, the only practical way of producing technically certified rubber is for it to become a premium rubber and there are no signs that anyone is prepared to pay a premium, at least for the present.

5. Rubber dealers referred to the claims made in America for the superiority of synthetic over natural

rubber in many fields. Have the producers' research stations examined such claims by testing the new synthetics against natural rubber ? What are the possibilities of improving the quality and properties of natural rubber by changes in or new methods of preparation ? Cannot the producers give the dealers a better product to sell ?

6. The dealers further observed that there was still much room for improvement in the quality of Malayan rubber which could be brought about by a thorough overhaul of the existing organization for packing, before introducing any additional complications. They stated that far too much rubber was being packed by new and inexperienced packers and immediate improvement in the situation would occur if the issue of packing licences were restricted to well-qualified and experienced packers. Dealers also stated that the quality of smallholders' rubber was improving, expressed approval of the steps being taken by the R.R.I. to further such improvement, and suggested the setting up of district organizations under responsible chiefs and village headmen to give further impetus to this promising development.

7. It was further observed that by far the largest American demand was for the lower grades of natural rubber at the cheapest price. This did not indicate that there would be a much greater demand for the producers' present product no matter how it was labelled or certified. To the market it seems that price rather than quality is of any significant importance to the big consumers.

8. A market representative, referring to figures quoted by producers' organization that the cost of testing and certification for modulus and plasticity was about 0.25 of a cent per pound, observed that a packer is fortunate if he can obtain a $\frac{1}{4}$ cent per pound gross on his turnover—specification rubber would have no attraction for the dealer unless it could be sold at a premium. Market members further stated that in the event of introduction of any form of grading on technological tests, testing stations should be set up to provide free services.

9. It appeared that all representatives of market organizations held the view that little would be gained by the introduction of technical grading without much closer contact between producer and consumer than at present existed. One market representative, stressing the need for co-operation, suggested the formation of a consulative

body of producers, dealers, the market organizations and the manufacturers to further the objects of this meeting.

Observations by Producers' Representatives (Groups B & C)

10. Representatives of a large producing organization stated that the most efficient producers do at present produce rubber that is better in its general qualities than any form of synthetic that has been produced so far. But synthetic rubber is sold on technical specification, at no extra cost to the manufacturer, which enables him to use the exact material he requires in his many different processes. The proposal to supplement the existing classification of types of natural rubber by specification of those properties of the greatest importance to the manufacturer should be regarded as a first essential step in an all-out effort to place natural rubber on a firmer competitive basis with rival products. The earlier and inconclusive attempts to supply certified rubber *at a premium* are not relevant to this discussion. We must first produce certified rubbers in sufficiently large quantities, sell them to the manufacturer and then improve them in such ways as may be required by the users' demands before considering at all any question of premiums. The problem must be regarded as involving work on a large scale ultimately.

11. Planting representatives observed that the first steps proposed did not appear to involve any radical changes in present methods of preparation of solid rubber for export. The majority of producers are not organised in large producing units, therefore, if specification grading is to be of real value the means must be found to apply it to the produce of the majority of producers. These would involve an all-out effort in organization and heavy capital expenditure in the establishment and operation of testing stations. Further it would probably be necessary to make radical changes in present methods of marketing.

12. Representatives of smallholder producers stressed the need to extend the benefits of improved production and grading methods to the smallest producer whose produce represented at least 40% of the country's production. The speakers strongly supported the principle of centralization as indicated in the recommendations (e) and (f) from the previous sessions and observed that a strong

case might be made out for assistance in material and finance from Government or other official sources, to enable the small producer to benefit by the orderly improvement in the value of his produce envisaged by the proposals now under discussion.

13. Further speakers from the producing industry whilst recognising the desirability for immediate action on the matter of specification grading, emphasized that it was equally urgent to intensify research on improvement in the intrinsic properties of natural rubber. It would be necessary to guard against too great a concentration of effort on immediately applicable measures to the detriment of research.

An appreciation of the Position of Natural Rubber

14. At this stage the meeting heard with the greatest interest and attention an authoritative appraisal of the current position in America as it concerns the need for technical grading of natural rubber, and the possible benefits to be expected*. Dr. E. M. McColm said that he had listened with alarm and misgiving to some of the observations made in the course of this discussion. It was quite clear that many of the members present recognised and accepted the need for a thorough overhaul and revision of the existing production and marketing organizations for natural rubber, as applied to all but the most advanced producing units. But several members had stressed the difficulties involved in introducing changes and put forward reasons why, in their opinion, they could not be carried out in practice.

It was pointed out in the first place that the major consumers of natural rubber in America no longer made their purchases on the basis of appearance. Every large manufacturer assesses the technical values of the different market grades for himself, and balances their relative advantages against current prices. It is not the market organization but the technical staff of the factory that dictates the policy of the buyer, and it is because the technologists know they can make a satisfactory tyre from No. 4 R.S.S. that the buyer is instructed to take advantage of its price discount over No. 1 R.S.S. The technical men are dissatisfied with current methods of delivery of natural

* Text of Dr. McColm's remarks appears on page 254.

rubber which compare unfavourably with those of synthetic. Synthetic is constantly gaining ground because it is the product of the vigorous, highly organised chemical industry whose constant aim is to seek to *improve* its products and to reduce their cost. For no political reason at all, but as the inevitable expression of this driving force, the American synthetic rubber industry is straining every nerve to replace natural rubber entirely. There is a good deal of confidence in America that success will be achieved in a matter of five to ten years. To counter this threat it was forcibly argued that natural rubber producers must abandon their pre-war outlook and mentality and meet the synthetic producer on his own ground. It is useless to ask the American manufacturer what he wants, worse than useless to ask for premiums. Natural rubber must be produced in improved forms and offered to the manufacturer at a competitive price, backed by a technical sales service. Technical grading should be regarded as only a first step in this direction, since technologists are all agreed that the value of natural rubber will be enhanced thereby. The value of different grades to the manufacturer can only be ascertained by experience, the market values cannot be accurately forecast. Technical grading must not be thought of as a permanent or comprehensive solution of the problem, it is only to be regarded as the framework within which natural rubber will in future be offered in new forms each having specific advantages. Only in this manner can the war with synthetic be waged and the future of the natural rubber industry viewed with hope.

Because the speaker was exceptionally well acquainted with the problems of both the synthetic and the natural rubber industry, and similarly well-informed as to the progress being made towards their solution, the meeting was urged to accept the argument *that it is of the most vital concern to the industry to offer natural rubber in improved types and to discuss immediate steps to this end.* Immediate difficulties must not prevent action, a concerted plan should be drawn up, requiring co-operation of all sections of the industry. Money will be needed and it will be necessary to consider how this shall be raised. The most practical immediate step would be to set up a small committee to consider and report what action is needed and to take such action vigorously before it is too late.

Discussion of action required.

15. The meeting, impressed by the lucid and forceful statement by Dr. McColm, proceeded at once to consider ways and means to give effect to the principal recommendations of the technical sessions (reported in paragraph 3 above).

Members favoured a proposal to set up forthwith a first committee to consider and report on action to be taken. It was generally agreed that this committee should be a small one with power to co-opt and should include representatives of the producers and representatives of the marketing organizations with research officers and technologists. It would be the job of this first committee to examine the available information, to decide what further research work and statistical investigation are required, and to plan the organization and staff needed to put the essential work in hand.

It was further suggested that there should also be a second committee, consisting preferably of experienced business men, who would receive the recommendations of the first committee, and take all necessary steps to provide finance for the work to be done.

16. Members suggested that it would be advisable, for the guidance of the first committee, to indicate the general scope of the scheme to be considered. For example, should a scheme of technical grading for Malayan rubber be formulated independently and without reference to similar plans in other territories ? The meeting agreed that since French producers had already initiated a scheme the proposed Committee should first examine the application of a similar scheme for Malaya. It would be undesirable for different territories to adopt plans for specification grading that differed materially. Co-operation in the formulation of technical grading schemes with other producing territories should therefore be as close as possible with the ultimate aim of international agreement in the definition and marketing of specification grades.

[The meeting adjourned at 1.00 p.m. and resumed at 2.30 p.m.].

17. After dealing with minor points arising from the morning's discussions and with comments arising from the papers contributed and circulated before the meeting, members resumed discussion of proposals for setting up the special committee as outlined in paragraph 15 above.

Proposals and Resolutions

18. The following formal proposal was put to the meeting:

> *" That this meeting form itself into a body to be called the Technical Organization of Natural Rubber Producers, Malaya, whose objective will be to promote by all means the improvement of the quality of natural rubber."*

19. In support of the proposal it was stated that although there are already various organizations in Malaya that are concerned with rubber, there is no single organization whose main object is to improve the quality of rubber. The proposed organization should operate as a " needle " organization and spare no effort to get work done whilst there is still time. Such an organization might work in the same manner as the existing latex producers' organization, which has had close co-operation from the latex consumers. The proposed organization for solid rubber should come to be regarded by consumers all over the world as the body that will do all that can be done to improve the quality of natural rubber.

20. Several members stated that as they were present at the meeting only as representatives from their respective Associations and Companies, they were not in a position to commit their principals to membership of any association or committee until they had reported the results of this meeting.

21. The meeting agreed unanimously that the proposal in paragraph 18 above should be referred to the several bodies represented at the meeting, with a strong recommendation for its adoption.

22. Pending a decision on the proposal to form the Technical Organization envisaged in paragraph 18, it was further resolved to appoint an ad hoc committee to begin work without delay. The following nominations were made and accepted:—

Representatives of Producers' Organizations—

Mr. C. Thornton
Mr. Khoo Teik Ee
Tuan Sheikh Ahmad bin Sheikh Mustapha
Mr. I. Sibiriakoff

Representatives of Market Organizations—

Mr. F. J. Kemlo
Mr. Heah Joo Seang

Rrpresentatives of Research and Technical Organizations—

Mr. C. E. T. Mann
Mr. M. W. Philpott
Dr. Geoffrey Gee
Dr. E. M. McColm } co-opted members.

23. It was agreed that a draft report of the proceedings at the meeting should be prepared by the R.R.I. and circulated to all members present.

24. Visitors from research organizations in other territories tendered thanks for invitations to be present at the meeting and to take part in the discussions.

(The meeting terminated at 3.45 p.m.)

Natural Rubber Versus Synthetic

Statement made by Dr. E. M. McColm, Technical Director of the Plantations Division of the U.S. Rubber Co., at the 3rd Session held on September 13th, 1949.

" The comments to which I have listened this morning indicate that people here generally are unfamiliar with the method followed by the American rubber manufacturer in choosing the grades of rubber he purchases. Take for example the tyre division of any large manufacturer. His technical men have determined by many careful experiments just what grades of rubber are required in each of his tyres to produce the competitive quality required. Thus, for example, suppose it has been shown that the desired quality is obtained using Grade 4 smoked sheet, and that no economically worthwhile improvement can be obtained using a higher quality sheet. Suppose, further, it has been shown that the same quality tyre is obtained using an equal mixture of Grade 3 and Grade 5 smoked sheet, or of Grade 2 sheet and, say, Grade 3 brown crepe. The technical man, usually known as a compounder, charged with the job, is constantly following the price of rubber, and will order for use in that particular tyre the thus approved grade or combination of grades having the lowest average cost. His orders are ultimately collected in the hands of that company's crude rubber buying division, who merely execute them. This crude rubber buying division will generally have its own rubber inspectors who inspect a given sample of each purchase to insure that it meets the R.M.A. appearance specifications for the grade ordered, and who will of course make a claim against any lot which is found not to meet these appearance specifications. But these are more or less by-products of the system, for in the final analysis it is the technical man who judges the rubber's performance and it is he who must be sold on the value of any improvement. Conversely, if he becomes sold, because he has found that the improved rubber offers a monetary, or quality advantage which justifies its purchase, then that company's buyer will get his orders and the new rubber will be purchased.

Don't ever forget, therefore, that in the American

market, at least, it is generally the technical man who is the final judge of what rubbers shall or shall not be purchased, and it is therefore the technical man whom you must convince of the value of any rubber offered for sale. The present system of visual grading is a superposition, useful only because of the lack of a grading system based on intrinsic properties.

The proposals made at this meeting are being made for the purpose of providing a measure of technological information as to the intrinsic physical properties of each lot of rubber shipped from Malaya, and this information is aimed directly at the technical men who determine rubber-buying policy.

I believe it is important for you to realise just what you are up against in the matter of competition from synthetic rubber in order that you may be able to judge how important to your continued business life this matter is.

In the final analysis, you are competing with the American synthetic chemical industry, a very competitive business which was suckled on our war needs in World War I, and weaned and attained manhood in the 1920's and 1930's in which hard, tough competition was the order of the day—every day, in every week, in every year. Out of this grew the competitive technique which is being used now to sell synthetic rubber. It involves intensive research by teams of chemists, physicists, and engineers, very careful attention to quality and to uniformity, combined with clever advertising. The watch-word in the chemical industry is that he who cannot constantly improve his product, *and lower its cost*, mark that, *and lower its cost*, may not stay in business long.

I am quite familiar with the type of research being done on synthetic rubber, and with some of the men doing it. I can most gravely assure you that they are largely men who have grown up in this competitive atmosphere, and they are generously supplied with the competitive spirit. Their present goal is a product or group of products which will equal or excel natural rubber in overall average quality. They are not anti-British or anti-Dutch or anti-French or anti anybody or anything. They are not even anti-natural rubber. They are merely very pro-synthetic rubber. They are in a competitive game—if you like—with the quality of natural rubber as the

goal. And, mark you also, they are not thinking about the premiums they may be able to charge for this improvement or that, but how to get these improvements at a lower cost !

Now contrast that picture with the condition of the natural rubber industry. Here you are still thinking in the pre-war groove where there was only one rubber—natural—and he who wanted it had to come to you to get it. Your selling technique, the open market, is as antiquated as the Ark and about as useless in the present war you have on your hands with synthetic. The synthetic research and development men regularly sit down with the rubber manufacturers' technical men to determine how synthetic rubber can be altered to better serve their needs. They are the real synthetic protagonists and salesmen. Yet you sit in your offices and wait for the American manufacturer to come to you to buy your product, and when he buys it he gets a commodity that is much dirtier than synthetic, nearly 100% more variable in most of its important physical and chemical properties, and therefore much more difficult to use in the modern high-speed, streamlined, rubber factory which was geared during the war years to using a much less variable, and more high-temperature-resistant synthetic. True, it is still superior to the best synthetic in some properties, tensile strength, resilence, and others, and it is that superiority which is the only reason why anyone still buys your product. Given equality, or even equality in some properties, and the choice, under present conditions, is likely to be synthetic every time.

What have you done to date to meet this synthetic competition ? Isn't it true that, outside of your research stations you have done absolutely nothing, other than to demand that America buy more natural rubber and less synthetic, and at a higher price for natural ? Why do you suppose that in 1948 America consumed about 170,000 tons more synthetic rubber than the legal mandatory requirement ? Isn't it obvious that superior processing and technical quality had something to do with it ?

The proposals made at this meeting are to the effect that you begin to do something about this situation by indicating two important characteristics of each lot of rubber shipped, namely, rate of cure and plasticity. Although this is admittedly only a beginning, it is at least something, and will enable the buyer to reduce very

markedly his operating difficulties, which are due to variability. Even more important, it will indicate to him that you are prepared to do something about quality, and are actually doing it !

So far, at this meeting, all I have heard has been why these proposals couldn't be put into effect. Do you suppose we in America created and built a synthetic rubber industry in time to help win a war by thinking up all the reasons why it couldn't be done ? I tell you that it's time we in Malaya realised we are in a serious war with synthetic rubber and that we now have no time to waste in devising ways by which we can't do anything about quality. For it is my considered opinion that if we ride along as we are doing now, paying no attention to the variability of rubber or to improving its quality, we may easily be out of business within ten years.

I am convinced that we here in Malaya have just as much ingenuity, and just as hot a spark as the people who created the synthetic rubber industry. But we can't let the research stations do it alone, for it will take the wholehearted co-operation of the planter, large and small, the dealer, the broker and the exporter.

I would therefore suggest that this meeting form itself into a permanent organisation to further the improvement in the quality of natural rubber; that as a first step it appoint a committee to investigate and determine how a certification scheme can best be set up, and a second committee of business men charged with finding the necessary funds and getting it going. Thank you."

SECTION 3

ABSTRACTS OF TECHNICAL CONTRIBUTIONS

Some Problems Involved in Grading and Testing Natural Rubber

By W. P. Fletcher

British Rubber Producers' Research Association.

1. The report discusses tests which may be used for the classification of rubber according to the properties of its vulcanisates.

2. Work on the variability of plantation rubber has hitherto been based on the modulus of standard vulcanisates at more than 500 per cent. This type of criterion is unsatisfactory because it evaluates the vulcanisates in a condition which occurs in very few practical applications; a modulus test at low (less than 250 per cent) extension is therefore preferred.

3. A test is described which consists in hanging a standard weight (1 Kg.) on a moulded test piece and noting the extention of the rubber after one minute. The equipment used for the test is an adaptation of the U.S. Bureau of Standards Strain Tester which can be constructed very cheaply.

4. The choice of a standard compound for evaluating raw rubber is discussed. A familiar A.C.S. mixing is rejected because it is sensitive to the humidity of storage of the vulcanized stock and reasons are given for preferring a mix accelerated by MBT/DPG.

5. Any test specification must take account of the minimum strain attainable and the time of cure giving this value. Modulus at a single cure is not a satisfactory criterion; for specification purposes it is proposed that tolerance limits should be specified for strain at 3 levels of cure.

6. In published work on rubber variability mixing errors have frequently been ignored. Data are quoted showing the importance of these errors and the dependence of minimum strain estimates on the Mooney viscosity of the uncured compound.

7. Preliminary data are presented on samples obtained from 11 Malayan Estates, variation within the samples being demonstrated by both the A.C.S. and MBT/DPG formulae.

Provisional Proposals for Methods of Testing to be Adopted to Grade Crude Rubber to Technical Specifications

By C. M. Blow

British Rubber Producers' Research Association

1. Proposals for equipping testing stations are based on the assumption that the unit of grading will be 10 tons and that one unit size testing station will deal with 25 samples daily, equivalent to 250 tons of rubber.

2. A statistically sound sampling procedure will have to be devised.

3. Cleanliness may be estimated visually or by dissolving the sample in a rubber solvent and then weighing the insoluble residue.

4. Processing properties are assessed by determining the Mooney viscosity. This test does not give a full picture of the processing characteristics but it is widely used in U.S.A.

5 Vulcanization characteristics are determined in a standard mixing accelerated with MBT/DPG. A specified mixing procedure is outlined and it is emphasised that duplicate mixings should be prepared from each sample of rubber, preferably on different days.

6 Standard vulcanizing moulds are described and the vulcanizing conditions are specified. It is recommended that duplicate test pieces should be moulded from each mixing at each of 3 cures viz. 20, 40 and 70 mins. at 138°C. Cured test-pieces are pulled in the strain-tester under a load equivalent to 10 Kgm./sq.cm.

7. Tentative limits are set up for standard rubber with respect to dirt content, viscosity, and percentage strain at 20, 40 and 70 minute cure.

8. Estimates are made of the equipment and personnel required for a unit testing station capable of testing 25 samples of rubber a day.

The Relations between the Modulus and the other Mechanical Properties of Rubber Vulcanized in the Captax Test Mixture

By J. W. Dalfsen

Indonesian Institute for Rubber Research

(Summarized from INIRO Communication No. 50)

Many manufacturers and laboratories characterize different rubbers on the basis of tests at a single vulcanization period. The purpose of the work described was to get the maximum amount of information possible from such tensile test results, using the Schopper dynamometer and normal ring test pieces. Tensile strength at 700% elongation of a vulcanisate cured for 60 minutes at 127°C in the A.C.S. (captax) test mixture was selected as the reference observation (TS 700).

Data were obtained of tensile properties at 20, 40, 60, 80, 100 minutes vulcanization at 127°C for about one hundred samples of rubber of various origins and different methods of preparation covering a wide range of variability in vulcanization time and mechanical properties.

For each cure scatter diagrams were prepared for TS 700 (60′) against modulus at 600% elongation (TS 600), TS 700, tensile strength at break (TSB), elongation at break (EB), Shore hardness (H).

An example of the 29 scatter diagrams given in Communication No. 50 is attached to the paper.

Only the relations between TS 700 (60′) and the other moduli could be fitted by a rectilineal regression line. In all other instances curved lines were obtained which could be approximately expressed by the second degree polynominal $y = a + bx + cx^2$.

The 29 regression equations, the corresponding correlation coefficients and the standard deviations were calculated.

From the high correlation coefficients and moderate standard deviations it follows that TS 700 (60′) is indeed characteristic of the properties obtainable after any given vulcanization period. It is therefore possible to judge whether the mechanical properties (in the A.C.S. mixture)

are normal or inferior; in dubious cases a second vulcanization for a longer period is desirable.

Comparison of data in the literature with data calculated from TS 700 (60′) and the regression lines gave good agreement.

By the method of trial and error limits were selected for TS 700 (60′) corresponding to the optimum cure, defined as the period of vulcanization to reach maximum tensile strength.

A provisional table is given as follows:—

Optimum Cure (min.)	Corresponding Limits of TS 700 (60′)	Rate of Cure
30	99½	very fast
40	74½—99½	fast
60	54½—74½	medium
80	39½—54½	slow
100	39½	very slow

Rapid Determination of the Content of Dirt in Rubber

By W. J. van Essen

Indonesian Institute for Rubber Research.

A method of determining bark, sand, etc. in rubber is described in which:—

(a) The sample is well masticated with the aid of of a plasticiser (5 minutes),

(b) Dissolved in boiling toluene with the aid of copper oleate (1 hour),

(c) Centrifuged in a graduated tube which shows directly the volume of the dirt in the sample (15 minutes).

Identification of Rubber Coagulated with too much Sulphuric Acid

By J. C. De Neef

Indonesian Institute for Rubber Research.

Rubber which has been prepared with excessive sulphuric acid at first looks normal but after 8-12 months it tends to become soft. It is therefore of importance to work out a method whereby such rubber can readily be identified at the time it is to be exported.

Experimental samples were prepared in the form of:

(1) Sheet, without washing

(2) Sheet, with normal washing during machining

(3) Crepe

from latex coagulated with:

(a) formic acid, normal dose

(b) sulphuric acid, normal dose

(c) sulphuric acid, 2 x normal dose

(d) sulphuric acid, $2\frac{1}{2}$ x normal dose.

The crepes from latex coagulated with sulphuric acid were slower drying, particularly (c) and (d).

The ageing properties of the raw rubbers were assessed by (A) visual inspection (B) plasticity measurements, after heating the sheet samples for 3 hours at 140°C, and the crepes for 7 hours at 110°C.

In test (A) decreased resistance to the ageing conditions was shown by the sulphuric acid samples (b) being a little inferior to (a) (normal formic), and (c) and (d) markedly inferior.

The plasticity figures from test (B) showed less marked differences.

Rate of vulcanization and ageing properties of the vulcanisates were studied in the A.C.S. test mix.

The period of vulcanization necessary to reach optimum tensile strength was in general longer for sulphuric sheets although it did not vary in a regular manner with the dose of coagulant.

Vulcanisates from the (d) group ($2\frac{1}{2}$ x normal dose) had much lower 600% moduli than those of the (a), (b) and (c) groups. A greater drop in tensile strength during hot air Geer oven ageing was apparent for (c) and (d) group vulcanisates.

A suitable rapid test for determining whether an excessive amount of sulphuric acid has been used during coagulation is the heat test for 3 hours at 140°C. In this test sheets prepared with formic acid remain practically unchanged, whereas considerable softening and flow occurs with sheets prepared with sulphuric acid.

Coagulation with Sulphuric Acid

By H. C. Baker and M. W. Philpott

Rubber Research Institute of Malaya

The published evidence that sulphuric acid produces undesirable qualities in plantation rubber is inconclusive because it is based on obsolete methods of evaluation. An experiment was therefore set up in which rubber coagulated under controlled conditions was tested by methods related to modern technological practice. It was confirmed that sulphuric acid—coagulated rubber vulcanizes slowly in rubber-sulphur mixings but is not defective in other respects.

A supplementary study of smallholders' sheets coagulated with sulphuric acid and with formic acid failed to disclose any gross disparity between the quality of formic and sulphuric acid samples.

APPENDIX 1

REPORT ON THE DEVELOPMENT OF CENTRALIZED MANUFACTURE OF SMOKE SHEET RUBBER BY SMALLHOLDERS

L. R. Davidson

Rubber Research Institute of Malaya.

Development of Centralized Manufacture of Smoked Sheet Rubber by Smallholders

Introduction

It is the intention of this paper to endeavour to describe the origin and working of various projects which have aimed to improve the quality and value of smallholders' rubber as a means of increasing the return to the peasant cultivator, and the overall reputation of the quality of rubber exported.

It is not claimed that the several projects described have been initiated by the Rubber Research Institute nor have we exercised the complete degree of control of organization which might have been desirable from an experimental stand-point. We have however, been generally responsible for guidance on technical requirements and the information contained in this paper has been obtained from those Field Officers of the Institute, including the Rubber Instructors and Demonstrators, who have been in close touch in advisory capacities with the several projects.

Early developments

From its inception in 1934 till the outbreak of the Japanese war the efforts of the R.R.I. Smallholders' Advisory Service were directed, so far as rubber manufacture was concerned, to the improvement of the individual peasant's product by providing information on the necessary simple equipment required by the small-scale producer and advice on appropriate technique for the manufacture of sheet rubber. Considerable initial improvement was possible particularly in those areas which had previously turned out a form of slab rubber suitable only for re-milling. The propaganda efforts required to maintain the first improvement were high and a considerable deterioration was to be expected in the period following the re-occupation.

Lack of equipment, shortage of supplies, particularly good acid, and the break in teaching can be considered contributory factors in the decline. The high cost of labour and the need for diversion of effort for obtaining food reduced the incentive to the small producer to take

that extra care which is necessary in the production of a first quality product. The high cost of labour has emphasized the lack of economy in small-scale smoking of rubber and the unsettled conditions of the country have contributed to make the smallholder unwilling to leave his rubber in one of the flimsy small smoke-cabinets which had seemed a suitable development in more peaceful times.

It is against this general background that we have sought for alternative means for the production of first quality rubber from smallholdings.

Co-operative Rubber Marketing Society, Ijok, Selangor

The Marketing Society at Ijok was formed in 1939 and commenced operations with about 40 smallholder members. It resumed operations after the war and membership has now increased to about 100 persons whose holdings are within a radius of two miles of the preparation centre, consisting of a coagulating shed, smokehouse and store.

Formed under the Co-operative Societies Department essentially for the co-operative marketing of members' rubber, the society has always had the use of a central smokehouse belonging to one of the members. To this has been added a coagulating shed, a store and a second smokehouse giving a smokehouse capacity of 70 pikuls of rubber.

Members may use the central coagulating shed or they may carry out the coagulation and machining of sheet rubber on their own holdings. But the equipment used in all cases is that of the peasant holder, namely individual coagulating pans, a single smooth mangle and a marker mangle. The improvement in quality obtained under this scheme, which has regularly produced a high proportion of R.S.S. 1, can be attributed to the incentive provided by sale, on grade, direct to a rubber exporter and to the simplification of advisory work provided by the meeting of large number of producers at the central manufacturing centre.

Kampong Smokehouse, Sungei Chinchin

The longstanding successful operation of the Ijok venture appeared to provide a model for further extension of the principle of co-operative manufacture of rubber by smallholders, but the continued efforts of Field Officers of the Rubber Research Institute and Co-operative

Societies Department have not been successful in the promotion of further societies on the same lines.

Towards the end of 1947 in consultation with the Department of Agriculture and the Co-operative Societies Department it was decided that since lack of capital was the reason generally advanced by peasant communities for inability to form Co-operative Societies, assistance in the establishment of a communal smokehouse might, in suitable instances serve to establish co-operative manufacture on a firm basis.

Smokehouses with cheap temporary fabrics of gunny sacking and bamboo were designed and the smallholder communities were required to play their part by provision of locally available materials and in the erection of the buildings. Materials which had to be purchased were provided by the Department of Agriculture.

Three smokehouses were erected in selected areas during the early part of 1948 but of these only one, at Sungei Chinchin, was ever used for smoking rubber. This smokehouse was in operation for about eight months and provided a useful profit to participants by the production of high grade rubber sold direct to an exporter's godown. Unfortunately, the smokehouse at Sungei Chinchin was burnt down on 9th February 1949. Despite the early success of the venture, there was no enthusiasm on the part of the community to replace the burnt smokehouse with a more substantial building.

The general difficulties in the way of establishing co-operative ventures, even with initial financial assistance, were shown by these trials to result from the dependance of the smallholder on his village rubber dealer, and the ready acceptance by the rubber dealer of the challenge to his trade.

Latex Purchasing in Trengganu

Since the latter part of 1948 a scheme for the purchase of smallholders' latex and manufacture of good sheet rubber has been developed by an enterprising smallholder rubber grower and rubber dealer, Che Nik bin Haji Jusoh of Telok Pasu, Trengganu, with the advice and encouragement of the Rubber Instructor, Kuala Trengganu.

Che Nik has for long operated one of the large smokehouses seen on the Trengganu River which smoke rubber obtained from the interior. Che Nik has now

organized a series of coagulating centres at suitable points in the district. These centres are provided with only the simple equipment used by smallholders in the manufacture of sheet rubber, namely, individual coagulating pans, sieves and one smooth and one marker mangle. These coagulating sheds are in the charge of agents who purchase latex on d.r.c. as estimated by metrolac and pay a price equivalent to the price of unsmoked sheet Grade 3.

About 80% of the rubber produced by this scheme can now be graded R.S.S. 1 which is a very considerable improvement on normal smallholder production. The improvement must be attributed to specialization of labour, close attention to details of preparation and the incentive of better marketing facilities. There is no doubt that attention will be paid in the future to obtaining any improvements in equipment which may be justified by the expansion of the organization.

Smallholders' Latex as a Source for Latex Concentrates

It is appropriate at this stage to record the investigation into the possibilities of utilizing latex from smallholdings in the preparation of latex concentrates carried out by one of the larger planting companies engaged in the production of creamed and centrifuged latices.

A suitable area of small-holding rubber was selected at Merbok in Kedah and a collecting centre arranged. Information on the intentions of the scheme was given to smallholders in the district by the local Rubber Instructor who carried out an intensive campaign on the special need for cleanliness of utensils and the importance of avoiding contamination or adulteration of latex by tappers. The price offered based on dry rubber content was approximately 5 cents per pound (which included duty) below the Singapore price for R.S.S. 1 so that the scheme was very attractive to smallholders. Collection started in February 1948 and was at the rate of approximately 350 gallons per day by October.

Though the latex produced reached a fairly high standard of cleanliness it was found to be unsuitable for the needs of the purchasers who decided to discontinue the purchase of latex for the preparation of concentrates as soon as an alternative scheme could be arranged to deal with the smallholders' latex in this area.

Central Factory at Kampong Batu Hampar*

With the prospect of the loss of the market for liquid latex in the Merbok area it was felt that an opportunity had arisen for investigating the possibilities of smallholders' latex being handled in a small central factory operated by smallholders themselves.

Haji Ahmad bin Haji Omar who had been an agent for the purchasers in the latex buying scheme was anxious to collaborate and with financial assistance he has been able to erect a small factory, shed and temporary smokehouse. The factory situated at Kampong Batu Hampar, is equipped with three 150 gallon coagulating tanks with aluminium partitions, two smooth and one marker mangles and other accessory equipment.

Four labourers, including a smokehouse operator, are responsible for the factory work and the daily output has reached 3½ pikuls. Good quality smoked sheet has been produced and over 90% marketed as R.S.S. 1.

Conclusions

The disproportionately high effort required to maintain improvement in the quality of individual production by smallholders can be traced to the natural impatience of a person who has to deal with only a few pounds of rubber each day.

The use of excess acid to reduce the time for coagulation, the elimination of certain processes, particularly adequate washing of the sheet, are perhaps natural reactions of people who have other subsistence needs to satisfy.

Similarly, the small quantities involved for each individual do not encourage proper attention being paid to provision for curing and storage and this is a stage at which much quality value is lost.

Recent experience in several complementary developments in the processing of smallholders' rubber has indicated clearly the marked improvement in quality which can readily be obtained by some measure of centralization of manufacture and specialization of labour in the production of smoked sheet. Equipment has not been of critical importance in improving quality; the most suitable type of equipment must be determined by the scale of each enterprise.

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* An account of the working of this scheme has since been published in Journal, R.R.I.M., Vol. 12, Communication 268.

Ideally for the smallholder, the necessary organizations should be developed through the co-operation of producers. However, response to continued advice on this subject from Co-operative Officers and Rubber Instructors has not been encouraging, and the economic importance to the country of the improvement in quality of smallholders' rubber may justify alternative means for securing centralized manufacture of sheet rubber.

Manufacturing centres could be established by co-operative effort, or by state or private enterprise. The possible improvement in the value of the smallholders' share of the country's rubber produce is high by whatever method the change in manufacturing methods is secured.

Finally, the system of centralization may have a greater importance for smallholders in that it may enable them more readily to adopt improved techniques which research may make available.

L. R. Davidson

APPENDIX 2

SPECIFIED RUBBERS

(Abridged translation of "Les Caoutchoucs Specifies" issued by Institut Francais du Caoutchouc et Institut des Recherches sur le Caoutchouc en Indochine, 1949)

Specified Rubbers

Rubber Growers of Indo-China have recently agreed on the principle of marking commercial crude rubber according to its intrinsic qualities.

The classification of rubber on its external appearance and cleanliness has for along time been strongly criticised on the grounds that it enables a rubber of not necessarily the best mechanical properties to be sold at a higher price than another rubber having excellent properties but a less attractive appearance. An article on this important question has already been published in the Revue Generale du Caoutchouc.

Marks for technically graded rubber have been agreed upon by the French producers and the first shipments of marked rubber are now arriving in the French market.

Some Definitions

It is necessary first to study two important definitions; what is meant by the terms 'specified rubber' and 'special rubber'.

A '*specified rubber*' is a rubber of normal type, which has no special characteristics except that it bears marks enabling the user to recognise the essential properties of the consignment (plasticity, rate of vulcanization).

A '*special rubber*' is a rubber which exhibits with considerable uniformity definite technical characteristics. There are two sorts of special rubber:

(i) Special rubbers which are simply homogeneous; the properties of these rubbers are not very different from the average of standard rubbers, but their variability is considerably reduced.

(ii) Special rubbers with particular properties; these rubbers have one or several properties which differ from those of average rubber, and exhibit a high degree of uniformity.

Principles of Marking

Two criteria have been adopted for grading, namely, Mooney viscosity and rate of vulcanization.

The Mooney viscosity is measured on the raw rubber. It characterises the plasticity of the raw rubber and its

processing (mastication and mixing) properties. It indicates the quantity of energy needed for breaking down the rubber to the plasticity required by manufacturers.

The choice of Mooney viscosity as a criterion of plasticity was determined by the simplicity and reproducibility of the test. Most well-equipped laboratories possess a Mooney viscometer; or if they have not it is easy to establish a relationship between Mooney viscosity and the measurements obtained with compression plastimeters of the Williams, Goodrich, Defo, and other types. The French Rubber Institute intends to publish results of a study on this subject and to suggest an improved test for plasticity which can be carried out with compression plastimeters.

Raw rubbers are divided into three groups of Mooney viscosity, the limits adopted being the following:

Rubber of low plasticity; i.e. with a Mooney viscosity of more than 87°—marked with a cross (X)

Rubber of medium plasticity; i.e. having a viscosity between 87° and 73°—marked with a circle (◯)

Rubber of high plasticity; i.e. rubber with a viscosity below 73°—marked with a line (—).

The choice of these marks is based on a mnemonic; a cross signifies more (plus) Mooney degrees, a line less (minus) Mooney degrees, and a circle indicates the intermediate position.

The rate of vulcanization is estimated by vulcanizing for a definite time and measuring the modulus. Numerous tests made in the East show that this measure gives a classification which, with very few exceptions, corresponds closely with a classification obtained by determining the optimum time of cure for the same mix.

The test is carried out according to the rules of the French specification T. 43-001. The composition of the test mix is the same as that of the mix recommended by the Crude Rubber Committee of the A.S.T.M., i.e.:—

Rubber	100
Stearic Acid	0.5
Zinc Oxide	6
Sulphur	3.5
Mercaptobenzthiazole	0.5

With this mix, samples are vulcanized at a temperature of 127°C. for 40 minutes. From the samples thus vulcanized Schopper rings of type A are cut according to the French specification T.46-002.

The modulus at 600 per cent. elongation, expressed in kg/cm^2 is the measure by which vulcanization rate is judged. If the modulus is less than 30 the rubber is said to be slow vulcanizing; if it is between 31 and 50 the rubber is medium vulcanizing; if it is above 50 the rubber is fact vulcanizing. The corresponding colour marks are:

Red for slow,
Yellow for medium,
Blue for last vulcanizing rubber.

Again it will be noted that the marks have a mnemonic significance.

The signs (cross, circle or line) corresponding to the plasticity are applied on the bale in the colour (red, yellow or blue corresponding to the rate of vulcanization. To illustrate as clearly as possible how the marking is made a diagram is attached showing the different marks together with the numerical values corresponding to the plasticity and rate of vulcanization for each grade.

It is to be noted that the marks corresponding to plasticity and rate of vulcanization are superimposed on the existing commercial classification. The new marks are an additional indication intended to help the consumer by showing the intrinsic properties of the commodity in addition to the conventional market quality. There will thus still remain in the market smoked sheet No. 1 and No. 2, brown crepes, etc. The new marks add new data for the technician but do not leave out any of the advantages of the usual grading. The various grades will continue to be sold at the same price, without any premium.

Advantages of Using Specified Rubbers

What are the advantages for a manufacturer of using specified rubbers ?

We note first of all that there can be no disadvantage since, at the worst, the user continues to process the rubber without paying any attention to the technical grading marks.

The chief advantage is the possibility of avoiding the difficulties associated with rubber with variable properties. These difficulties are well-known and include:

(i) Wastage caused by poor vulcanization. In the factory when a batch of slow vulcanizing rubber replaces a batch of fast vulcanizing rubber a large percentage of products may well be spoilt before the reason is known and the remedy found.

(ii) Bad calendering and extruding resulting usually from variations in rubber plasticity. There may also be scorching in the extruders as a result of an unexpected change from a soft and slow rubber to a hard or fast one.

(iii) Variations in the rubber may show up in differences in the quality of the finished goods.

The technical grading marks will reduce these difficulties considerably and will save the manufacturer money. The way of using the marks will differ according to whether the consumer is a large or a small manufacturer.

The small manufacturer will always find it best to use the same type of rubber. It will be easy for him to get his supplies as he does not need large quantities.

Larger consumers have two courses open to them: they can either blend their stocks or adapt their manufacturing processes to suit each batch of raw rubber. The former method is the one usually adopted; rubbers from different sources are blended in order to smooth out the differences between them.

It is not a very efficient method unless the blend is made up of rubber from a considerable number of sources; this means carrying large stocks—which is expensive. By systematically blending on the basis of technical grading marks however, it is feasible to make combinations of uniform rate of cure from relatively small stocks.

The other method used by the consumer for dealing with rubber variability is to test each batch and adapt the manufacturing process to suit the particular properties of the rubber. If the technical properties of the material are already known from the grading marks it is easy to apply this method in the factory. It is simply necessary to ascertain in advance the relationship between the processing treatments or curing times suitable for rubber of different plasticity or rate of vulcanization. Moreover, because of the uniformity of the specified rubber, it is possible to reduce the margin of safety and formulate more economical mixings.

Altogether it is estimated, having regard to the advantages already mentioned, that the use of certified grades will entail an increase of between 2% and 10% in the manufacturer's profit. This is without taking into consideration the advantages of reduced inventories, shorter times of mastication and a more objective basis for negotiating claims against suppliers.

The rubber consumer thus finds in specified rubbers a powerful weapon to reduce his costs, to increase his production and to improve his technique.

Future Prospects

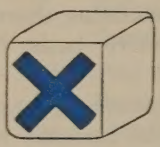
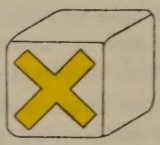
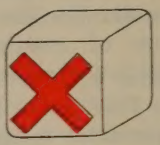
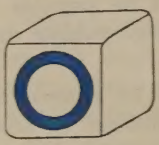
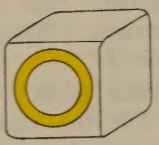
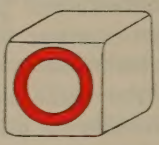
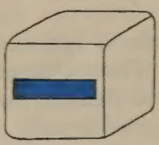
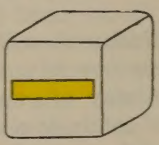
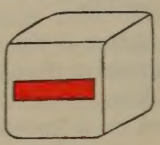
It is anticipated that the scheme will effectively reveal manufacturers' preferences. Thus it will be possible at last to answer the question, " What kind of rubber does the manufacturer require ? "

For some applications certain types of rubber are preferable to others. For the rapid moulding of small articles " blue " rubbers will be chiefly required, because they will enable the user to reduce the amount of added accelerator. Some users will also wish to reduce the power consumed in mastication by using " line " rubbers as much as possible.

After a time manufacturers will be able to introduce progressive changes in commercial custom. These changes, resulting from the free play of supply and demand and based on a knowledge of intrinsic qualities, are greatly to be preferred to any violent revolution in the existing situation.

Later it will be possible to direct rubber production towards the most popular grades. The number of criteria of quality may be increased. For instance, characteristics derived from carbon black mixings may be introduced into the standards. Consumers will soon recognise the most suitable applications for each type, and this will be an important step forward from ordinary rubber to specified rubbers, and later to special rubbers.

IDENTIFICATION OF SPECIFIC RUBBERS

 Viscosity above 87 Fast Vulcanisation	 Viscosity above 87 Medium Vulcanisation	 Viscosity above 87 Slow Vulcanisation
 Viscosity between 73 and 87 Fast Vulcanisation	 Viscosity between 73 and 87 Medium Vulcanisation	 Viscosity between 73 and 87 Slow Vulcanisation
 Viscosity below 73 Fast Vulcanisation	 Viscosity below 73 Medium Vulcanisation	 Viscosity below 73 Slow Vulcanisation

Marking.

Red — Slow Vulcanization: Modulus 600% less than 30 kg/cm².

Yellow — Medium Vulcanization: Modulus 600% from 30 to 50 kg/cm² inclusive.

Blue — Fast Vulcanization: Modulus 600% greater than 50 kg/cm² for A.C.S. mix vulcanized for 40 minutes at 127°C.

Viscosity in Mooney Units.